

Records of *Carcharhinus limbatus* and *C. plumbeus* (Chondrichthyes: Carcharhinidae) from off the Balearic Islands (NW Mediterranean)

by

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ABSTRACT. - The blacktip shark *Carcharhinus limbatus* and the sandbar shark *C. plumbeus* are reported for the first time from off the Balearic Islands. Identification of both specimens was based on jaw and dentition analysis. These records extend the known distribution of these species in the Mediterranean. Their occurrence and abundance in the area, especially in the north-western basin, is discussed.

RÉSUMÉ. - Captures de *Carcharhinus limbatus* et *C. plumbeus* aux Baléares, Méditerranée occidentale.

Le requin bordé *Carcharhinus limbatus* et le requin gris *C. plumbeus* sont signalés pour la première fois aux îles Baléares. L'identification des deux spécimens est fondée sur l'analyse des mâchoires et de la dentition. Ces signalements étendent la distribution de ces deux espèces en Méditerranée ; leur présence et leur abondance dans le secteur, spécialement dans le bassin nord-ouest, sont discutées.

Key words. - Carcharhinidae - *Carcharhinus limbatus* - *Carcharhinus plumbeus* - MED - Balearic Islands - New records.

The blacktip shark *Carcharhinus limbatus* (Valenciennes, in Müller and Henle, 1839), and the sandbar shark *Carcharhinus plumbeus* (Nardo, 1827) are two widely distributed species in tropical and temperate waters. They both are inshore and offshore pelagic sharks, found on or adjacent to the continental and insular shelves, but not truly oceanic. In the eastern Atlantic they occur from Zaire northwards to Madeira and Morocco, and they are also present in the Mediterranean Sea (Compagno *et al.*, 2005; Serena, 2005). The information on the abundance of *C. limbatus* and *C. plumbeus* in the Mediterranean is scarce, and data from monitoring programs of pelagic fisheries show an extremely low abundance of both species in the by-catch composition (e.g., Di Natale, 1998; Orsi Relini *et al.*, 1999; Castro *et al.*, 2000; Mejuto *et al.*, 2002; Megalofonou *et al.*, 2005).

In this note, the occurrence of the blacktip and the sandbar sharks is reported for the first time from off the Balearic Islands (NW Mediterranean), and an overview of their distribution in the Mediterranean is presented.

MATERIAL AND METHODS

The blacktip shark was captured in May 1977 off Dragonera Island (SW Mallorca; Fig. 1). The shark was feeding

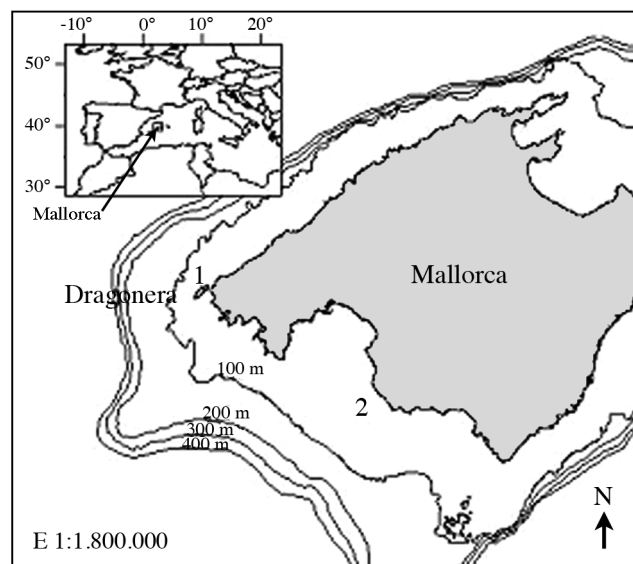


Figure 1. - Map showing the locations off the Mallorca coast where the *Carcharhinus limbatus* (1) and the *C. plumbeus* (2) specimens were captured. [Carte indiquant la localisation au large de la côte de Majorque où les spécimens de *C. limbatus* (1) et *C. plumbeus* (2) ont été capturés.]

at the surface on two greater amberjacks *Seriola dumerili* (Risso, 1810) hanging from a spearfisherman buoy that sub-

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sequently captured the shark with his speargun. The capture locality (39°35'00"N-2°18'30"E, NW side of Dragonera Island) is characterised by high cliffs that extend down to 60 m depth and, as well as in the rest of the northwestern Mallorca coast, a narrow (~15 km) insular shelf exists. The total length of the shark was not recorded, but it was visually estimated to range between 150 and 200 cm. The jaws of this specimen were extracted, cleaned and air dried, and kept in the personal collection of the fisherman (Mr. B. Mayrata).

The *C. plumbeus* specimen was captured in September 1991 south of Palma Bay (~39°17'N-2°43'E; Fig. 1) with a drifting pelagic longline targeting for swordfish *Xiphias gladius* (Linnaeus, 1758) over 70 m depth approximately. The specimen was landed at the Palma de Mallorca port. Its size could not be reported due to its capture was not notified, although the jaws were subsequently given to one of the

authors (G. M.) and deposited at the *Museu Balear de Ciències Naturals* (Sóller, Balearic Islands; catalogue number: Cat. MBCN 12790).

The identification of the two sharks was based on the analysis of their jaws and dentition, since no additional material (head or photographs) was available. Likewise, data on the sex of both specimens could not be obtained.

DESCRIPTION OF THE MATERIAL STUDIED

Carcharhinus limbatus

The teeth showed dignathic heterodonty (Hermann *et al.*, 1990). The upper teeth had narrow triangular cusps on broad bases, without secondary cusplets (Fig. 2A). The anterior teeth (positions 1-3) were nearly symmetrical, whereas the



Figure 2. - Teeth of the *Carcharhinus limbatus* specimen. **A**: Position 7 from the right upper jaw. **B**: Positions 3, 4 and 5 (from right to left) from the right lower jaw. Teeth of the *Carcharhinus plumbeus* specimen. **C**: Positions 2 and 3 (from left to right) from the left upper jaw. **D**: Positions 1 and 2 (from right to left) from the right lower jaw (Scale bar = 1 cm). [Dents du spécimen de *C. limbatus*. **A** : Position 7 de la mâchoire supérieure droite. **B** : Positions 3, 4 et 5 (de droite à gauche) de la mâchoire inférieure droite. Dents du spécimen de *C. plumbeus*. **C** : Positions 2 et 3 (de gauche à droite) de la mâchoire supérieure gauche. **D** : Positions 1 et 2 (de droite à gauche) de la mâchoire inférieure droite (Barre d'échelle = 1 cm).]

posterior teeth were slightly oblique, with their cusps pointing to the corner and showing concave distal edges. The last three posterior teeth (positions 13 to 15) were considerably smaller. The teeth bases were more coarsely serrated compared to fine serrations on the edges of the cusps. The upper jaw had two small symphyseal teeth.

The lower teeth (Fig. 2B) showed broader bases and narrower cusps than the upper teeth. No secondary cusplets were present. The teeth were nearly symmetrical, the last three (positions 13-15) being minute. The edges of some cusps appeared to be serrated but not clearly visible. Two symphyseal teeth were present, being similar, although smaller, to the rest of lower teeth.

This description coincided with those given for *Carcharhinus brevipinna* and *Carcharhinus limbatus* (Bigelow and Schroeder, 1948). However, relative tooth size in *C. brevipinna* is smaller (Bigelow and Schroeder, 1948; Soldo, 1996), whereas the teeth of *C. limbatus* are noticeably larger and more robust (Bigelow and Schroeder, 1948; Siqueiros-Beltrones, 1990). The latter author considered tooth size difference as one of the main distinctions between the two species. Regarding the presence or absence of serrations on the lower teeth, previously considered as a key characteristic for distinction (Bigelow and Schroeder, 1948), Branstetter (1982) stated that serrations of lower teeth were found in both species, and therefore it should not be used as a key feature for distinguishing between *C. brevipinna* and *C. limbatus*.

The dental formula of the examined jaws was:

15 – 2 – 15

14 – 2 – 14

This formula differs from that given for *C. brevipinna* from the Mediterranean (Soldo, 1996) and from other seas (Bigelow and Schroeder, 1948; D'Aubrey, 1964; Garrick, 1982; Gubanov *et al.*, 1986; Gubanov, 1993). The dental formula of the examined specimen agrees with those for *C. limbatus* given by Branstetter (1982) and Siqueiros-Beltrones (1990), who clearly stated that the dental formula separate *C. brevipinna* and *C. limbatus*, as the latter species has a lower number of teeth. Branstetter (1982) provided another characteristic of the jaws, which can be used for distinguishing between those two species: the posterior trailing edge of the mandible of *C. brevipinna* is straight, but a distinct notch is present in mandibles of *C. limbatus*. This feature was present in the studied jaws (Fig. 3), therefore confirming that it belongs undoubtedly to *C. limbatus*.

Carcharhinus plumbeus

The teeth showed dognathic heterodonty (Hermann *et al.*, 1990) (Fig. 4). The upper teeth (Fig. 2C) were broadly triangular, the first two anterior teeth being nearly symmetrical. The posterior teeth were increasingly oblique, and decreas-



Figure 3. - Jaws of the *Carcharhinus limbatus* specimen captured off Mallorca. The arrows mark the notch used as a key character for identifying this species (Scale bar = 10 cm). [Mâchoires du spécimen de *C. limbatus* capturé à Majorque. Les flèches signalent le caractère diagnostique utilisé pour identifier cette espèce (Barre d'échelle = 10 cm).]

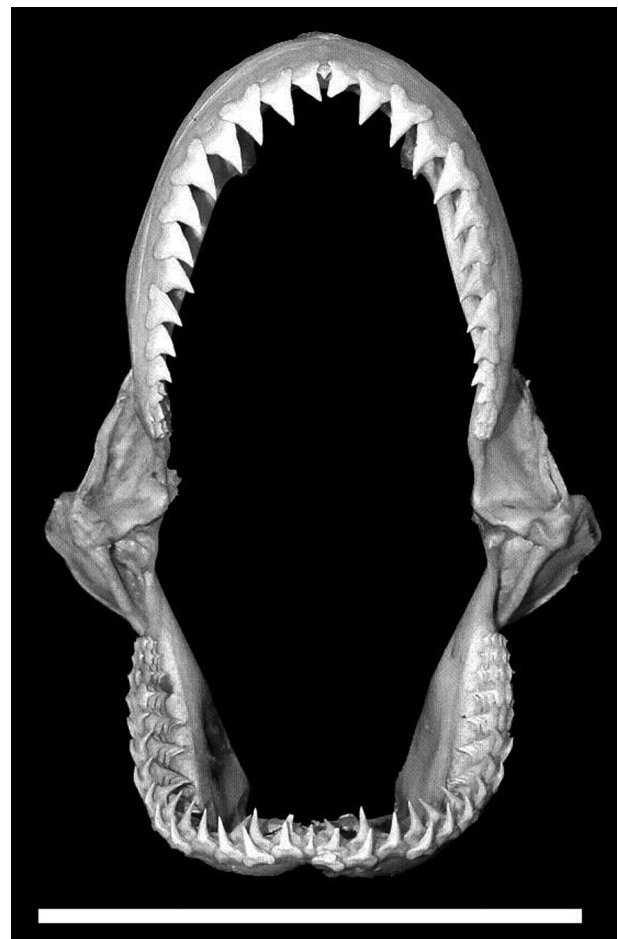


Figure 4. - Jaws of the *Carcharhinus plumbeus* specimen captured off Mallorca (Scale bar = 10 cm). [Mâchoires du spécimen de *C. plumbeus* capturé à Majorque (Barre d'échelle = 10 cm).]

ing successively in size and height relative to breadth from position 10 towards the corner. The cusps and bases of the

upper teeth were finely serrated. There were no secondary basal cusplets. The symphyseal tooth was significantly smaller, with serrated edges and without secondary basal cusplets.

The lower teeth were erect, symmetrical, with narrow triangular cusps on broadly expanded bases, and without secondary cusplets (Fig. 2D). The bases were mainly smooth-edged, while the edges of the cusps were serrated, but more finely than those of upper teeth. The lower symphyseal tooth was significantly smaller, showing smooth edges. This description corresponds to those given by Bigelow and Schroeder (1948), D'Aubrey (1964) and Soldo (1996) for *C. plumbeus*.

The dental formula of the examined jaws was:

$$\frac{14-1-14}{14-1-14},$$

coinciding with that of *C. plumbeus* specimens from the Mediterranean (Soldo, 1996), and also falling within the range of formulas given by Bigelow and Schroeder (1948), D'Aubrey (1964), Cadenat and Blache (1981), Gubanov *et al.* (1986) and Gubanov (1993).

DISCUSSION

Carcharhinus limbatus has been reported to occur from Spain to Italy (but not in the Adriatic) in the northern range of the Mediterranean, and from North African coasts to Turkey in the southern part (Branstetter, 1984; Bilecenoglu *et al.*, 2002). Nevertheless, the status of the blacktip shark within the Mediterranean differs among authors. Cadenat and Blache (1981) considered the species to occur occasionally. Fergusson (1994a) reported the species as fairly common in the Mediterranean, being more abundant from Tunisia to Israel, where it could be frequently confused with *Carcharhinus brevipinna* (Fergusson, 1994b). Also, regional differences in the abundance of the species seem to exist. In the western basin the blacktip shark has been scarcely recorded. Moreno (1982), Hemida and Labidi (2002) and Hemida *et al.* (2002) did not report any specimen, whereas Capapé *et al.* (2004) reported only one individual from Algerian coasts. In the central Mediterranean, *C. limbatus* seems to be slightly more abundant, as suggested by some records reported by Capapé (1974, 1975), Capapé *et al.* (2004) and Quignard and Ben Othman (1978) from Tunisian waters, although it was considered as very rare in the area by Bradaï (2000). Instead, the blacktip shark has been reported to occur mainly in the eastern Mediterranean basin (Ben Tuvia, 1953; Fredj and Maurin, 1987), although Golani (2006) considered the species as rare off Israel.

Carcharhinus plumbeus is a more common species in the Mediterranean than its conspecific *C. limbatus*. The sandbar shark has been recorded throughout the Mediterranean,

including the Adriatic (Branstetter, 1984; Tortonese, 1987; Lipej *et al.*, 2004; Bilecenoglu *et al.*, 2002), and it seems to be more common in the central and eastern areas. In the western basin few records of the species exist. Off Spanish coasts, only four confirmed specimens have been reported (Gibert, 1913; Lozano Rey, 1928; Moreno, 1982). Two additional specimens were recorded from Ligurian (Orsi Relini *et al.*, 1999) and Tyrrhenian (Consoli *et al.*, 2004) seas, and also Di Natale (1998) reported its occurrence therein. Off the Algerian coast, *C. plumbeus* was considered previously as rare (Hemida and Labidi, 2002), but recent reports showed that it should be considered as a permanent inhabitant in that area (Hemida *et al.*, 2002). For Tunisian waters, Quignard and Ben Othman (1978) and Bradaï (2000) reported its occurrence in the Gulf of Gabès related to its tropical affinity, from where it would extend to the southeastern Mediterranean. Fergusson (1994a) described the species as common off Sicily, and very common off southern Tunisia, where a pupping and nursery area exists in the Gulf of Gabès (Capapé, 1984; Saïdi *et al.*, 2005). Also, the sandbar shark has been recently reported as common off the Libyan coasts (Séret, 2006). In the Adriatic Sea recent studies have shown that the species appears occasionally as by-catch (Soldo and Jardaš, 2002). Based on caught neonatal and juvenile specimens, the Adriatic has been suggested as a nursery area for this species (Lipej *et al.*, 2000; Costantini and Affronte, 2003). Finally, the Levantine basin has been described as a centre of local abundance of *C. plumbeus* within the Mediterranean (Saïdi *et al.*, 2005, and cited therein; Golani, 2006), and also Öztürk (2006) reported a nursery area of the species in Turkish waters.

Off the Spanish Mediterranean coasts, *C. plumbeus* was only recorded by Gibert (1913) and Lozano Rey (1928), whilst any *C. limbatus* record exists. Therefore, the two records reported herein become important due to the apparent scarcity of *C. limbatus* and *C. plumbeus* off the Spanish Mediterranean coasts and in the northwestern Mediterranean as well. This is especially important for the blacktip shark, since only Di Natale (1998) reported it previously. Although this author did not provide the precise location of capture in the Ligurian and Tyrrhenian seas, those specimens together with that reported in the present paper seem to be the northernmost records of *C. limbatus* in the Mediterranean Sea.

The Balearic Sea is a region where water masses from the south (warmer and fresher, of Atlantic origin) and north (colder and of higher salinity, from the Gulf of Lions) meet (García *et al.*, 1994). As well as the Algerian coasts, the southern Balearic area is influenced by waters of Atlantic origin, mainly during the warmer months (Millot, 1999). As the temperature of water masses has been stated as one of the main factors driving the distribution of carcharhinids in the Mediterranean (Moreno, 1982; Morey and Massutí, 2003), this could explain the higher abundance of *Carcharhi-*

nus spp. in the southern range of the western Mediterranean, specially off northern African coasts (most of the captures being recorded during the warmer months; Hemida *et al.*, 2002), as well as their occurrence off southern Mallorca coasts (Morey and Massutí, 2003; and present work).

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